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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/856,209	05/18/2001	Kozo Nakamura	82822	6736

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EXAMINER
SONG, MATTHEW J

ART UNIT	PAPER NUMBER
1765	8

DATE MAILED: 03/04/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

A-8

Office Action Summary	Application No.	Applicant(s)	
	09/856,209	NAKAMURA ET AL.	
	Examiner	Art Unit	
	Matthew J Song	1765	

-- The MAILING DATE of this communication appears n the cover sheet with the correspondence address --

Peri d for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 December 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *3,7-10,13 and 14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *3,7-10,13 and 14* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 8 and 10 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 8 recites, "and an oxide film withstand the voltage is 60% or higher at a C mode ratio". The instant specification states "if the C mode yield for the GOI is 60% or higher, the crystal can be regarded as better than crystals normally in use" on page 16. There is no support in the specification for an oxide film.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claim 8 and 10 recites the limitation "the voltage" in line 3. There is insufficient antecedent basis for this limitation in the claim, likewise for line 5 in claim 10.

5. Claims 8 and 10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 8 recites "and an oxide film withstand the voltage is 60% or higher at a C

mode ratio" in lines 3-4. It is unclear if applicant intends the amount of oxide film capable of withstanding a voltage is greater than 60% or if applicant intends voltage is 60% or greater than a C mode ratio amount of voltage, likewise for claim 10.

6. Claims 8 and 10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 8 recites "and an oxide film withstand the voltage is 60% or higher at a C mode ratio" in lines 3-4. The grammar of claim 8 is flawed, it appears a verb is lacking between "film" and "withstand", such as "can" or "able to".

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 7-10 and 13-14 are rejected under 35 U.S.C. 102(e) as being anticipated by Iida et al (US 5,968,264).

In a method of manufacturing a crystal ingot, note entire reference, Iida teaches a silicon single crystal grown through the use of a crystal pulling apparatus, where wafers were sliced from the thus-obtained silicon ingot (col 14, ln 20-67). Iida also teaches (Delta $G=G_e-G_c$) is not

greater than 5°C/cm, where G_e is a temperature gradient at the periphery and G_c is a temperature gradient at the center portion of a growing crystal (col 10, ln 5-15). Iida also teaches a G_c=30°C/cm (3.0 °C/mm) and a G_e=35°C/cm (3.5 °C/mm)(Fig 8), where the G_e/G_c ratio can be determined to be 1.16. Iida also discloses that wafers were sliced from the thus-obtained silicon ingot (col 14, ln 20-67) Iida also teaches an OSF region is observed between a N region, a neutral region having few defects, and a vacancy rich region and interstitial rich region (col 15, ln 1-15 and Fig 10A). Iida also teaches the G_c is the temperature gradient at a central portion of the growing crystal both in an in-crystal descending zone, 1300-1000°C, or in the vicinity of the solid-liquid interface of the crystal, melting point of silicon to 1400°C (col 4, ln 5-15 and col 4, ln 35-39), therefore G_c reads on applicant's $G1_{center}$ and $G2_{center}$. The value of 1.06x ($G1_{center}$ and $G2_{center}$)$^{-0.2}$ can be determined to be 0.68. Iida also teaches an OSF ring with an inner diameter of at least ½ a wafer inner diameter (Fig 10A) at a pulling speed of 0.62 mm/min.

Referring to claim 7, Iida teaches a similar silicon ingot as applicant's ingot of claim 7, it is noted that claim 7 is a product by process relationship and it is the applicant's burden to show an unobvious difference. Iida et al teaches a silicon ingot pulled by a CZ method under conditions similar to applicant.

Referring to claim 8, Iida et al teaches a similar method of forming a silicon ingot, as applicant teaches in claim 7, therefore an oxide film withstand the voltage of 60% or higher at a C mode ratio is inherent, absent evidence to the contrary.

Referring to claim 9, Iida et al teaches G_c=30°C/cm (3.0 °C/mm) and a G_e=35°C/cm (3.5 °C/mm)(Fig 8), where the G_e/G_c ratio can be determined to be 1.16 and a OSF ring occupying to crystal diameter ratio of greater than 0.5 and less than 1.06x($G1_{center}$ x $G2_{center}$)$^{-0.2}$ in Fig 10A.

Referring to claim 10, Iida et al teaches a similar method of forming a silicon ingot, as applicant, therefore an oxide film withstand the voltage of 60% or higher at a C mode ratio is inherent, absent evidence to the contrary.

Referring to claim 13, Iida et al teaches controlling a ratio of an OSF ring inner diameter to a crystal diameter (Fig 10A), and a controlling a temperature gradient at the edge and at the center.

Referring to claim 14, Iida et al teaches a density of void defects existing on the inside of an OSF ring reduced by expanding the inner diameter of the OSF ring in Fig 10A.

3. Claims 13-14 are rejected under 35 U.S.C. 102(e) as being anticipated by Hourai et al (US 5,954,873).

In a method to produce silicon single crystal wafers essentially defect-free, Hourai et al. teaches the V/G ratio is maintained at 0.20-0.22 mm^2/°C.min at the center of the crystal and V/G ratio is maintained at 0.20-0.33 mm^2/°C.min at the outer surface of the crystal, where V is the pulling rate (mm/min) and G is the temperature gradient (mm/°C) (col 3, ln 41-57). Hourai et al also teaches the diameter of the OSF ring can be controlled by the single crystal pulling rate and the inside-crystal temperature gradient in the axial direction in a high temperature zone from the melting point of silicon to 1300°C (col 4, ln 43-57). Hourai teaches the OSF ring develops at the intermediate positions with a no-defect region, this reads on applicant's limitation of perfectly crystalline part, formed outside the ring and a scattering faults develop inside the ring at slower pulling rates and the OSF ring develops at the periphery at higher rates. (col 6, ln 1-20 and Fig 1A) Hourai also teaches the pulling rate is changed as the crystal is pulled to compensate for

changes in the temperature gradient to maintain a constant V/G (col 6, ln 47-65) Hourai also discloses for medium velocity pulling a OSF ring develops at about one half the distance from the center of the silicon single crystal wafer (col 2, ln 1-8) Hourai teaches in Fig 4 a no defect region surrounding a OSF ring at various lengths of a silicon ingot.

Referring to claim 13, Hourai et al teaches controlling a ratio of OSF ring inner diameter to a crystal diameter (Fig 4) and thermal gradients at the edge and center of an ingot.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hourai et al. (US 5,954,873) or Iida et al (US 5,968,264) as applied to claim 2 above, and further in view of Luter et al. (US 5,922,127).

Hourai et al or Iida et al teaches all of the limitations of claim 3, as discussed previously in claim 2, except the single crystal ingot production is preformed while adjusting a distance between the silicon melt and a heat-shield member installed in a Czochralski method silicon crystal production equipment.

In an apparatus for pulling single crystals, Luter teaches a crucible mounted on a motorized turntable which raises the crucible to maintain the surface of the molten source

material at a constant level as the ingot grows and the source material is removed from the melt (col 3, ln 60-65) Luter also teaches a heat shield (40) mounted above the upper surface of the molten source material (col 4, ln 32-37). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Hourai et al or Iida et al with Luter to avoid undesired changes in the thermal profile during the growth process.

Response to Arguments

6. Applicant's arguments with respect to claim 3 have been considered but are moot in view of the new ground(s) of rejection.

7. Applicant's arguments filed 12/23/2002 have been fully considered but they are not persuasive.

In response to applicant's argument that the Iida reference does not teach G2 has been noted but has not been found persuasive. Claim 7 recites "(2) $0.5<$(OSF ring inner diameter/crystal diameter)$<1.06x(G1_{center}xG2_{center})^{-0.2}$" in line 4. The claim requires that the (OSF ring inner diameter/crystal diameter) ratio be between a value of 0.5 and $1.06x(G1_{center}xG2_{center})^{-0.2}$. Applicant's specification defines G1*G2 values of between 2 and 12, therefore the value of $1.06x(G1_{center}xG2_{center})^{-0.2}$ ranges from 0.62 and 0.92. The Iida reference teaches (OSF ring inner diameter/crystal diameter) between a value of 0.5 and 0.62 in Fig 10A at a pulling speed of approximately 0.62 mm/min, therefore meets the limitations of claim 7. Also, the examiner has previously stated the Iida reference teaches the G_c is the temperature gradient at a central portion

of the growing crystal both in an in-crystal descending zone, 1300-1000°C, or in the vicinity of the solid-liquid interface of the crystal, melting point of silicon to 1400°C (col 4, ln 5-15 and col 4, ln 35-39), therefore G_c reads on applicant's $G1_{center}$ and $G2_{center}$ and the value of 1.06x ($G1_{center}$ and $G2_{center}$)$^{-0.2}$ can be determined to be 0.68 for the G_c of 3.0°C/mm taught by Iida et al. Furthermore, applicant is reminded that claim 7 is directed to a product and although claim 7 recites process limitations, the patentability determination of a product-by-process claim is based on the patentability of the product and does not depend on its method of production (MPEP 2113). Applicant has not successfully demonstrated any differences between the silicon ingot of the closest prior, the Iida reference, and the instantly claimed silicon ingot.

In response to applicant's arguments regarding claim 13 have been considered but have not been found persuasive. The Iida reference teaches controlling a ratio of an OSF ring inner diameter to a crystal diameter (Fig 10A), and a controlling a temperature gradient at the edge and at the center. The Hourai reference teaches controlling a ratio of OSF ring inner diameter to a crystal diameter (Fig 4) and thermal gradients at the edge and center of an ingot. The examiner has previously stated the Iida reference teaches the G_c is the temperature gradient at a central portion of the growing crystal both in an in-crystal descending zone, 1300-1000°C, or in the vicinity of the solid-liquid interface of the crystal, melting point of silicon to 1400°C (col 4, ln 5-15 and col 4, ln 35-39), therefore G_c reads on applicant's $G1_{center}$ and $G2_{center}$. Control of G1xG2 is inherently controlled by controlling G_c. Furthermore, applicant is reminded that claim 13 is directed to a product and although claim 13 recites process limitations, the patentability determination of a product-by-process claim is based on the patentability of the product and does not depend on its method of production (MPEP 2113). Applicant has not successfully

demonstrated any differences between the silicon wafer of the closest prior, the Iida reference or the Hourai reference, and the instantly claimed silicon wafer.

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on 703-308-3868. The fax phone numbers for the

organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS
February 27, 2003

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